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17. ABSTRACT (MAX. 250 WORDS)

Of the seven objectives stated, two may be unique. They are: (1) To give pupils mastery of the basic mathematics formerly covered in grades 7 and 8--the fundamental operations, percentage, measurement, formulas, problems, and geometric concepts and constructions. (2) To introduce the basic concepts, terminology, and symbolism of contemporary mathematics by integrating it with the traditional content and by using it as supplementary material. Units are outlined for the subject areas listed under (1). Supplementary and instructional materials, references, visual aids, and sample assignments are included. Aids to planning are indicated by # for subject matter needing only brief consideration, and * for optional material.

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INTEGRATED MATHEMATICS
GRADE 7

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INTERGRATED MATHEMATICS: ADVANCED GRADE 7

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INTEGRATED MATHEMATICS ADVANCED GRADE 7

Objectives

* 1. To make the study and learning of mathematics stimulating, interesting, and vital.

2. To train the pupils to think, as well as to manipulate figures correctly.

3. To show that mathematics is a living, ever-growing subject and one vital to the challenging life of the Twentieth Century.

4. To acquaint pupils with the nature and kinds of numbers and number system.

5. To present the basic properties of number and operations.

6. To give pupils mastery, adequate for life situations, of the basic mathematics formerly covered in grades seven and eight; the fundamental operations; percentage; measurement; formulas; problems; geometric concepts and constructions.

7. To introduce, whenever possible, the basic concepts, terminology and symbolism of contemporary mathematics by integrating it with the traditional content and by using it as supplementary material.

Advanced Mathematics

Grade 7

\# Indicates subject is to have brief consideration

* Indicates optional material

Supplementary and instructional materials, references, visual aids, and sample assignments are at the end of the outline.

I Brief Introduction to Number Systems

A. Real Numbers

1. Rational numbers

a. Natural numbers (the counting numbers)

They include the positive whole numbers

b. Integers

They include the positive and negative whole numbers and zero. Thus the natural numbers are positive integers.

c. Other rational numbers

Common fractions, terminating and repeating decimals

2. Irrational numbers (cannot be expressed as quotients of integers)

Examples are non-terminating, non-repeating decimals; square roots of positive numbers which are not perfect squares.

B. Complex Numbers

This system includes all numbers of the form $3 + 2\sqrt{-1}$ (made up of real numbers and imaginary numbers).

Numbers like $\sqrt{-1}$ and $\sqrt{-6}$ are called imaginary numbers.

C. Basic Principles of the Arithmetic Processes for Natural Numbers

1. Associative law for addition

$$(a + b) + c = a + (b + c)$$

2. Associative law for multiplication

$$(a \cdot b) \cdot c = a \cdot (b \cdot c)$$

3. Commutative law for addition

$$a + b = b + a$$

4. Commutative law for multiplication

$$a \cdot b = b \cdot a$$

5. Distributive law for multiplication

$$a \cdot (b + c) = (a \cdot b) + (a \cdot c)$$

6. Principle of multiplication and division by zero

$$a \cdot 0 = 0$$

$\frac{a}{0}$ impossible

D. Understanding the Place System of our number system

1. Attention is to be called to the value given to a digit by virtue of the place that it occupies in the number

relative to the unit's place. Attention should also be given to the reading and writing of numbers, particularly the reading of decimals.

a. Example

3 represents three units in number 43, but

3 represents 3 (10's) in the number 36.

* Note: Binary system and other number systems could be introduced here.

E. Brief Introduction to the Basic Ideas of the Set Theory

1. Definition of a set
2. Notation
3. Kinds of sets
4. Uses

II Fundamental Operations and Numeration

A. Order of Operations

B. Mastery, at adult level, that is, adequate for ordinary life situations of the four fundamental operations with:

1. Whole numbers
2. Fractions in the common notation used for fractions
3. Fractions written in decimal notation

C. Develop ability to handle large numbers.

1. Ability to interpret simplified figures such as:

   7.5 million = 7,500

2. Ability to interpret and write large and small numbers by the use of the powers of 10.

III Percentage

A. Common uses in everyday life

B. Meaning of per cent

C. Changing per cents to decimals and fractions

1. Reason

2. Rules

D. Changing fractions and decimals to per cents

1. Reason

2. Rules

E. Memorization of equivalents

F. Fractional per cents and per cents greater than 100%

G. Cases of per cent

1. Finding the per cent of a number

$$P = BR$$

2. Finding what per cent one number is of another

$$R = \frac{P}{B}$$

3. To find a number when a per cent of it is known

$$B = \frac{P}{R}$$

(Note: Teach how formulas 2 and 3 are derived from $P = BR$ so pupils can solve for p, r, and t when interest formula is taken up.)

H. Applications

1. Baseball averages

2. Commission - finding commission, net proceeds, rate of commission

3. Discount
   a. Finding discount, marked or list price, sale or net price
   b. Rate of discount
c. Successive discounts
4. Per cent of increase and decrease
5. Profit and loss
   a. Selling price, margin, cost, expenses, gross profit, net profit
   b. Formulas
   c. Rate of profit and loss
6. Interest and banking
a. Banking services - making out checks, deposit slips, etc.
   b. Simple interest $I = prt$
      Solve also for p, r, and t
   c. Loans
      Promissory notes
      Bank discount and proceeds
Small loans
* d. 6% method
# e. Installment buying
# f. Insurance
*   Probability
# g. Taxation
      Property - finding community rate and computing individual tax bill
      Income
      Others

IV Measurement

A. Measurement of Length

1. Lines - types and definitions

a. Horizontal
b. Vertical
c. Oblique
d. Perpendicular
e. Intersecting
f. Arcs

2. Standard units of measurement - ability to convert a measurement from one unit to another

a. Inch
b. Foot
c. Yard
d. Rod
e. Mile

3. Drawing and measuring line segments

4. Names and definitions of common plane geometric figures

a. Rectangle	$P = 2(l + w)$
b. Square	$P = 4s$
c. Triangle	$P = a + b + c$
d. Parallelogram	$P = 2(a + b)$
e. Trapezoid	$P = a + b + c + d$
f. Circle	$C = \pi d$

B. Measurement of Area

1. Understanding of basic units of area

2. Ability to convert areas from one unit to another: sq. ft. to sq. yd. etc.

3. Formulas for finding areas of common plane figures.

a. Rectangle	$A = lw$
b. Square	$A = s^2$

c. Parallelogram $A = bh$

d. Triangle $A = 1/2\ bh$

e. Trapezoid $A = 1/2\ h\ (a + b)$

4. Practical applications of formulas to everyday problems.

C. Measurement of volume and surface area of common solids

1. Understanding of three dimensions

2. Recognition and identification of solid figures

3. Definitions of and formulas for finding volumes of the common solid figures.

a. Understanding of basic formula $V = Ah$ for rectangular prism, cube, cylinder

b. Understanding of basic formula $V = 1/3\ Ah$ for cones and pyramids

c. Formula for volume of sphere $V = 4/3\ \ r^3$

4. Principle of great circle of sphere as related to latitude and longitude on the earth.

5. Practical applications of volume formulas to everyday problems.

6. Understanding of surface area of common solid figures

a. Rectangular prism

b. Cube $A = 6\ s^2$

c. Cylinder curved surface $A = \pi\ dl$

total surface $A = \pi\ dl + 2\pi\ r^2$

d. Cone $A = \pi\ rs$ (s = slant height)

e. Pyramid

f. Sphere $A = 4\pi\ r^2$

7. Measurement of capacity

   a. Liquid measure

   b. Dry measure

   c. Measure of weight

   d. Conversion of measures from one unit to another: pints to quarts etc.

8. Relationship of volume, capacity and weight

   a. Practical applications involving weight per unit volume, etc.

9. Denominate numbers

   a. Fundamental operations involving compound numbers of two or more denominations

10. Measuring lumber

a. Understanding of board foot measure

V Geometric Concepts and Constructions

* Research assignment on the history of geometry

A. Lines

1. Meaning of basic geometric terms as :

a. Point
b. Line
c. Segment
d. Endpoint
e. Midpoint
f. Intersect
g. Perpendicular
h. Parallel
i. Half line
j. Ray
k. Interval
l. Arc

2. Geometric symbols

3. Constructions

a. Construct the perpendicular bisector of a line

b. Construct a line perpendicular to another line from a point outside the line.

c. Construct a line perpendicular to a line from a point on the line.

B. Angles

1. Concept of an angle

2. Measurement of an angle

a. Use of the protractor

3. Types of angles

a. Acute
b. Obtuse
c. Right
d. Straight
e. Round
f. Reflex
g. Vertical
h. Complimentary
i. Supplementary
j. Conjugate

4. Central angles and the measurement of arcs
5. Construct an angle equal to a given angle.
6. Construct the bisector of a given angle.
7. Consideration of the relationship of the angles formed when two lines intersect
   a. Review of vertical and supplementary angles
* 8. Draw two parallel lines and a transversal, and develop the relationship of the angles formed by the transversal
   a. If two lines make equal corresponding angles with a third (transversal) the lines are parallel.
   b. If two lines are each drawn perpendicular to a third line the lines are parallel.
   c. Construct parallelograms.

C. Triangles

1. Review of the triangle
   a. Types of triangles
      (1) Scalene (4) Equiangular
      (2) Isosceles (5) Right
      (3) Equilateral (6) Obtuse
2. The sum of the interior angles of any triangle is 180°.
3. Congruent triangles
   a. Meaning of congruence
      Rigid figures - non-rigid figures
   b. If three sides of one triangle are respectively eqaal to the three sides of another triangle, the triangles are said to be congruent.

d. If two angles and the included side of one triangle are respectively equal to two sides and the included angle of another triangle, the triangles are congruent.

d. If two angles and the included side of one triangle are respectively equal to two angles and the included side of another triangle, the triangles are congruent.

e. Practice in the construction and recognition of congruent triangles.

D. The Concept of Similarity

1. Prerequisite topics

a. Ratio and proportion

b. Simple equations

2. Similar Triangles

a. Similar right triangles

3. Construction of similar triangles

4. Properties peculiar to similar triangles

a. In similar triangles the ratio of any pair of corresponding sides equals the ratio of any other pair.

b. If two angles of one triangle are equal to two angles of another triangle the triangles are similar.

5. Applications

a. Indirect Measurement

* b. Numerical Trigonometry

6. Similar polygons
    a. Scale drawings

E. The right triangle and the Pythagorean Theorem
1. Squares and square root
    a. Squaring a number and the use of the exponent.
    b. Meaning of square root, finding the square root of a number, and the use of the radical.
    c. Using the square root tables
    d. Re-introduce the concept of rational and irrational numbers.
2. Pythagorean Theorem
    a. History
    b. Proof
    c. Application
    d. The converse of the Pythagorean Theorem and its application
3. The isosceles right triangle

F. Construction of plane geometric figures
1. Polygons
    a. Equilateral triangle
    b. Isosceles triangle
    c. Rectangle
    d. Pentagon
    e. Hexagon
    f. Octagon
2. Geometric design
3. Point and line symmetry
    a. Asymmetry

VI Graphs and Formulas

A. Reading, construction, and uses of:

1. Bar graphs
2. Line graphs
3. Pictograms
4. Circle graphs
5. Continuous line graphs

B. Use of symbols in formulas

C. Simple expressions and sentences involving variables

* D. Graphing of ordered pairs

Supplementary Material

The following enrichment units are suggested. Some will be entirely new to the traditional curriculum, for mathematics is a living, ever-growing subject; others have a familiar note. It is hoped that some of the basic contemporary topics can be introduced in order to familiarize the pupils with the new concepts, terminology, and symbols in modern mathematics.

I Further study

Perhaps the most important new concept in all modern mathematics is the set theory. It clarifies and unifies all branches of mathematics, being used in algebra , geometry, theory of probability, topology, and all the rest, and also in science and industry. This has been introduced under the number systems.

II The Binary Number System

Very helpful in teaching the notation of place value and practical because of its use in electronic computers. It is suggested that this be introduced after the study of place value in our number system.

III Theory of Probability

A rapidly growing branch of mathematics, originally concerned with games of chance, now useful in physics, astronomy, biology, economics, psychology, and all the social sciences. This may be introduced with the study of insurance.

IV Introduction to Theory of Numbers

One of the oldest and most delightful subjects in mathematics, concerned with the patterns formed by numbers in accordance with rules. This is especially useful in the study of decimals.

V Logic

Helpful in leading pupils to reason carefully. Since the vocabulary of logic and sets will sooner or later play an important part in elementary mathematics instruction, their early introduction is desirable. This could be taken up briefly with the introduction to Set Theory.

VI Cube Root

Interesting to the pupil if taken directly after square root. An excellent means of teaching accuracy and at the same time giving a review in fundamental processes.

VII Numerical Trigonometry

Can successfully be given at the seventh grade level and is of value during work on indirect measurement. Especially interesting to pupils if a surbeyor's transit can be obtained.

VIII The Slide Rule

Anyone from a seventh grade student up can learn, with just a little study and practice, to use this time and labor saving instrument. Even on the simplest instrument one can multiply, divide, square, cube, extract square and cube roots, etc.

IX Logarithms

If paper-covered tables of logarithms can be obtained this would make an interesting enrichment project. Logarithms were invented for the declared purpose of reducing the labor of computation with numbers. The slide rule is based on the theory of logarithms.

Instructional Materials

1. For constructions: protractors, rulers, compasses, draftsman's triangles.

2. Graphs (pictograph, bar, line, and circle) for reading (To be taken from newspapers and magazines)

3. Cross-ruled paper for drawing graphs (with the large squares)

4. For measuring length: foot rule, yardstick, meter stick; micrometer, odometer, pedometer, surveyor's tape, carpenter's rule

5. Surface measure: cut-outs of square inches, square foot, square yard, circles of various sizes, models of plane figures

6. Volume measure: models of solid figures, instruments for measuring liquid and dry measure

7. Pamphlets and booklets on bonds, stocks, insurances, tax rates, income taxes, etc.

8. Colored chalk

9. Colored pencils

Teacher References

** Principles of Mathematics - Allendoerfer & Oakley
Mc Graw - Hill

* School Mathematical Study Group
Junior High School Mathematics Units - Yale

** Mathematics Dictionary - Glenn & Robert James
Van Nostrand

* History of Mathematics - Florian Cajori
Mc Millan

* Slide Rule, How To Use It - Calvin Bishop
Everyday Handbook Barnes-Noble

** University of Illinois Committee on School Mathematics
First Four Units - Teacher's copy - Univ. of Ill. Press

** Experimental Mathematics Project for Grade 7
Hartung, Van Engen & Trimble
Fairlawn, New Jersey Office - Scott Foresman

The New Mathematics - Irving Adler
John Day Co.

Introduction to Mathematical Thinking - F. Waismann
Harper

Program for College Preparatory Mathematics
College Entrance Examination Board

Mathematics, Second Course - Brown, Gordey, Sward, Mayor
Prentice Hall

Modern Mathematics, Topics & Problems - Aiken & Beseman
McGraw-Hill

The Mathematics Teacher - Periodical

Mathematics for the Millions - Hogben
Norton

Makers of Mathematics - E. T. Bell
Simon, Schuster

A Short History of Mathematics - Vera Sanford
Houghton Mifflin

Mathematical Puzzles and Pastimes - Aaron Bagst
Van Nostrand

Pupil References

Everyday Arithmetic - 7 & 8 - Douglas, Kinney, Lenz
Holt

Sets, Sentences, Operations - Johnson & Glenn
Webster

Making Sure of Arithmetic - Morton, Gray, Springstun, Schaaf, Rosskopf
Silver Burdett

The Wonderful World of Mathematics - Hogben
Rathbone Books, London

* Those we would especially like to have

\# One per building

Paper-bound Books for Classroom Libraries

One Two Three ... Infinity	George Gamow	$.50
A Mentor Book		
The New American Library of World Literature		
501 Madison Avenue, N. Y. 22, N. Y.		
The Canteerbury Puzzles	H. E. Dudeney	$1.25
Dept. R. E. C.		
Dover Publications, Inc.		
920 Broadway, N. Y. 10		
Math Magic	Royal Heath	$1.00
Dover Publications		
Puzzles in Thought & Logic	C. R. Wylie	$1.00
Dover Publications		
Flatland	Edwin A. Abbott	$1.00
Dover Publications		
Mathematical Puzzles	Geoffrey Mott-Smith	$1.00
Dover Publications		
Magic House of Numbers	Irving Adler	$.35
A Signet Book		
The New American Library		
Makers of Mathematics	Alfred Hooper	$.95
Modern Library Paperbacks		
Random House, N. Y.		
Mathematician's Delight	W. W. Sawyer	$.65
Pelican Books		
Penguin Books, Inc.		
3300 Clipper Mill Road		
Baltimore 11, Md.		

Prelude to Mathematics -	W. W. Sawyer	$.85
Pelican Books		
Penquin Books, Inc.		
Mathematical Excursions	Helen A. Merrill	$1.00
Dover Publications, Inc.		

Sample Assignment on the Number System

This sample homework assignment could be used after the number system, the basic principles, and the place system have been taught, discussed and practiced in class.

It is assumed that the teacher has given the students either mimeographed pages or classroom notes on this material.

Our Number System

A. Complete the Following Thoughts:

1. The number system that we use most often today is called the _____ - _____ number system.
2. The nine digits, 1, 2, 3, 4, 5, 6, 7, 8, 9 came from the H_____.
3. It is generally agreed that the 0 was invented by the A_____ at a later date.
4. By place value we mean that a digit represents a number by virtue of its (place) in a numeral.
5. The regular way of writing numbers is called positional notation.
6. The number 756 means that you have ___(100) + ___(10) + ___(1).
7. Our number system has a base of (ten).
8. There are other systems of counting (or numeration) such as: _____, _____, or _____.
9. The natural numbers are (counting) numbers.

10. The Integers include __(pos.)__ and __(neg.)__ whole numbers and __(zero)__.

11. __(Irrat.)__ numbers cannot be expressed as the quotient of two whole numbers.

12. $\sqrt{-1}$ and $\sqrt{-6}$ are called __(Imag.)__ numbers.

B. Developing and Understanding of the Basic Principles of Mathematics

1. Regroup the following according to--

   a. The associative property of addition:

      (1) $(4 + 7) + 2 =$

      (2) $6 + (5 + 7) =$

   b. The associative property of multiplication:

      (1) $(9 \cdot 7) \cdot 8 =$

      (2) $5 \cdot (8 \cdot 4) =$

2. Change the order of the following according to the commutative property of--

   a. Addition: $340 + 560 =$

   b. Multiplication: $(5.67) .2 =$

3. Regroup the following according to the--

   a. Distributive property of multiplication: $6 (5 + 9) =$

C. Write the following as Decimals or Mixed Decimals

1. Sixty-five hundred-thousandths

2. Thirty-two and four hundred-thousandths

3. Two thousand two ten thousandths

D. Change these Decimals and Mixed Decimals into Word Statements.

1. $3.007 =$

2. $.9741 =$

Sample Assignment on Percentage

Suggested assignment after Cases I, II, and III have been taught.

Three or four drill examples:

1. 3 3/4 % of $4000
2. 15 is ____% of 109 (round off to hundredths)
3. 78 is 12 % of _____?
4. 250 is ____% of 80?

Three of four problems--depending upon which of the applications have been covered in class.

5. When Mr. Curtis ordered gym suits he received a discount of 15% for ordering a large number. Find the net price if Mr. Curtis ordered 325 uniforms at $2.30 each.
6. Mary bought a dress at the beginning of the summer. She paid $8.00 for it. Last week she saw a dress like hers on sale for $5.00. What was the rate of discount?
7. Paul had $40 in the bank. Now he has $82 in the bank. By what per cent have Paul's savings increased?

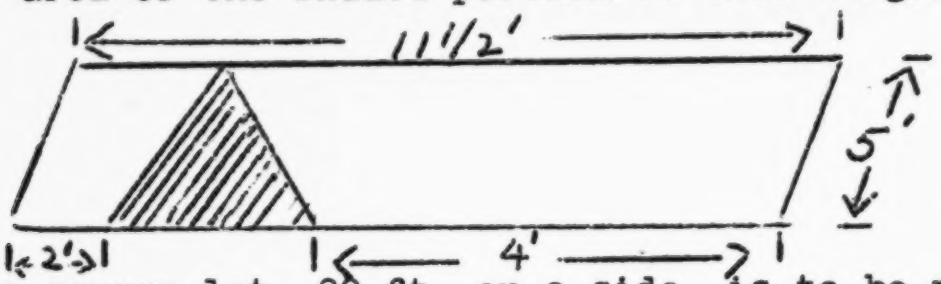
Sample Assignment on Measurement

This assignment is to be given after teaching areas of rectangle, square, parallelogram, and triangle. This assignment should take about thirty minutes of the student's time.

Using the correct formulas, and substituting in the formula solve the following problems.

1. Find the area of a triangle whose base is 23 in. and whose height is 1 1/2 ft. State answer in sq. in. and sq. ft.

2. Find the area of the shaded portion of this diagram.



3. Part of a square lot, 90 ft. on a side, is to be paved. The portion not being paved is a 3 ft. wide border extending around 3 sides of the lot. What is the area of the paved surface?

4. What is the cost of paving the lot in problem 3, if the contractor charges 75¢ per square yard of pavement?

5. Mr. Jones sold 3 rugs each measuring 9 ft. by 12 ft. and 2 rugs each measuring 12 ft. by 18 ft. If they sold at $9.75 a square yard how much in all did he receive for the rugs?

Sample Assignment on Geometric Construction

In the following examples you are to use only a compass and a straight edge (unmarked ruler) when working out the problem. You may use the protractor to check results.

1. On your paper draw a line A B. Assume that this line is six units long. Draw a line three units long.
2. Draw a straight line and on it construct:
   a. a 90^{o} angle
   b. a 45^{o} angle
3. Draw an equalateral triangle whose sides are equal to the line A _____B.
4. How large are the angles of the triangle you have drawn in problem 3? Remember you are unable to measure them directly. Explain your answer.
5. Draw an angle of 30^{o}. Explain in one brief sentence what you did.
6. Draw an angle of 120^{o}.
7. Draw an angle of 75^{o}.
8. Consider the work which you have done in problems 2 - 8, are there any other angles which you might be able to construct?
   What are they?

Sample Assignment in the Binary System

1. Write the following numbers in the binary system:

17	=	128	=	22	=
29	=	9	=	64	=
43	=	3	=	7	=
76	=	100	=	95	=

2. Write the following numbers in the decimal system:

1001 =

10000 =

11111 =

100 =

11001 =

Sample Assignment in the Theory of Sets

1. Designate by the listing method the set of all your teachers.
2. Using the listing method, write the set of
   a. The odd integers between 0 and 10
   b. The perfect square integers between 1 and 25 inclusive.
3. Choose the proper descriptive adjective--finite, infinite, null, or unit--for each of the sets below:
   a. The set of all the people in the world
   b. The set of all real numbers
   c. The set of all people who have fingerprints like yours
   d. The set of all the girls on the football team in your school.
4. How many subsets of the set (1,2,3,4,5) have exactly two elements?
5. From the sets given below, select examples of equivalent sets and equal sets.

a.	A = (●, 1, 3)	f.	F = (7, 3, 2)
b.	B = (0, 1, 4)	g.	G = (1, 0)
c.	C = (4, 6, 8, 10)	h.	H = (10, 14, 16, 9)
d.	D = (1, 5, 7, 11)	i.	J = (1, 0, 4)
e.	E = (0, 1)	j.	K = (11, 5, 1, 7)

Sample Assignment in the Theory of Probability

The law of large numbers may be stated thus:

If there are n equally likely events that can occur, and m of these events have a certain characteristic, then the probability that any event with this characteristic will occur in any one trial is $\frac{m}{n}$ . .

Applying this formula, solve the following problems:

1. If I take one ball at random out of a bag containing 4 black balls and 5 white balls, what is the probability that I shall take a black ball?

   Total number of balls = 9

   Number of black balls = 4

   Therefore, the probability that I shall take a black ball is $\frac{m}{n}$ =

2. If 6 cards are numbered from 1 to 6 and one card is drawn, what is the probability that it will be a 6? That it will be a 2? ans. 1/6 ans. 1/6

3. If a playing card is drawn at random from a deck of 52 cards, what is the probability that is will be the Queen of Hearts? ans. 1/52

4. A bos contains 8 white balls and 15 black balls. If a ball is drawn at random, what is the probability that it will be white? ans. 8/23

5. Among the digits 1,2,3,4,5 first one is chosen and then a second selection is made among the remaining four digits. Write down the twenty possible outcomes. Assume that each of the twenty is equally probable. Find the probability that both digits chosen are odd.
   ans. 6/20 = 3/10

Visual Aids That May Help in Teaching This Course

At the end of the Teachers Guide for American Arithmetic may be found a list of titles of sound films and filmstrips suggested by the authors of the text as being helpful in teaching this course.

The following is a list of sound films available from the Dept. of Audio Visual Aids, State Dept. of Education, Mt. Pleasant Avenue, Providence.

Congruent Figures
Language of Graphs
Latitude and Longitude
Meaning of Percentage
Meaning of "Pi"
Decimal Fractions
How to Divide Fractions
How to Subtract Fractions
Parallel Lines
Micrometer

This list is only suggested and the individual teacher may wish to use all or only part of these aids.

In addition to films and filmstrips, some other visual aids are: charts, models, flannel-boards, opoque projectors and overhead projectors.